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ABSTRACT

Four papers discuss the use of management information systems (MIS) in institutions for further education (that is, adult education) in England. A brief introduction notes the problems of initiating MIS during a time of declining financial support. The first paper presents arguments for the use of MIS at the technical college level, suggests areas that MIS should cover, and lists the criteria for evaluating MIS. Such a system, says this author, should be simple, unified, systematic, coherent, valuable to educators, and based on students' actual courses. The second paper describes the collection and analysis of MIS data at an institution with many part-time students and a large variety of attendance arrangements. In the third paper the author explains the MIS computer program developed at a college to manage class scheduling for teachers and departments. The final paper narrates the development of a management information center at a technical college and discusses the center's goals, staffing, resources, database, and problems. (Author/RW)

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MANAGEMENT INFORMATION SYSTEMS IN FE

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ASPECTS OF MANAGEMENT INFORMATION SYSTEMS IN FURTHER AND HIGHER EDUCATION

FOREWORD

DR DEREK W. BIRCH
DEPUTY DIRECTOR, COOMBE LODGE

Sibley (1977) has traced the evolution of planning in colleges and universities in Canada and the United States of America through three phases. Prior to the expansionist 60s planning was simple. For the most part the college was a peaceful enclave regarded by its environment with tolerance, perhaps even with "benign neglect". The internal coding was simple, coherent and stable. The information system was rudimentary but it sufficed. It was the age of "authority" and "empiricism".*

The late 60s and early 70s was an age of affluence and rising expectations. Colleges grew quickly and this growth in scale and complexity was accompanied by increased differentiation and specialisation of function. The pressures were enormous but the environment was supportive. More sophisticated information systems were developed and implemented and there was great confidence that problems would yield to analysis. It was the age of "rationalism" and "participation". Late in the 70s came the "Ice Age". The environment became critical - even hostile - "accountability" became fashionable. The enrolment curves flattened out and so did the support. This trend, taken with inflation, has squeezed out the "fat" from most colleges and is presently gnawing away at the "slack". Extrapolation from past experience is more precarious than at any other time. We have entered the age of "pragmatism" operating in a reactive and tentative way.

This description of the North American scene applies equally to the UK, except that the widespread implementation of management information systems has never been evident here. Does the current environmental uncertainty now argue against the development of college management information systems? It is certain that this development must now be carried out in a context of economic stringency and in the face of diminished institutional cohesion. Paradoxically the need to monitor shifts and trends in the patterns of resource utilisation and to account and justify outside and modify and persuade within the college is probably greater now than at any other time. In a world of plenty, options can always be found which make some parties better off and none worse off. In time of scarcity, situations abound where a gain to one means a loss to somebody else. Decisions ultimately reflect subjective judgements - and rightly so - for data and statistics alone are not sufficient. Nevertheless verifiable, quantified evidence narrows the choices facing the decision takers and may help to tease

out the inherent "logic" of the situation.

So far progress in the UK has been the result of college ini-iniatives. Such individualised solutions have the advantage of a high degree of "fit" to the idiosyncracies of the college in which they were conceived, but each college designing its own system from scratch implies duplication of effort (and mistakes) and is possibly wasteful of resources. There is an argument for some central investment in the development of a system of general application. Meanwhile we may profit by reports of each others' experiments. A number of case histories are available in the Coombe Lodge Information Bank. (See page 418). This collection of papers adds to that list.

David Humphreys sets out the arguments for a college management information system from a principal's viewpoint. He identifies the areas it would need to cover and summarises the criteria by which it might be judged. Dr K. Swinhoe and Dr J. Hartley describe the data collection and analysis presently operating at Doncaster Institute of Higher Education. Derek Wickham reports on the development of a computer assisted timetable analysis "package" at Tottenham. Finally, Dudley Gibson traces the development of the Management Information Centre at the North East London Polytechnic. He outlines the problems it encountered and points up some solutions.

* Sibley W.M.: Planning in Universities: The Contemporary Predicament. *International Journal of Institutional Management in Higher Education*. Vol.1.No.2.

THE DESIGN AND IMPLEMENTATION OF MANAGEMENT SYSTEMS: A PRINCIPAL'S VIEWPOINT

DAVID HUMPHREYS
PRINCIPAL, STOCKPORT COLLEGE OF TECHNOLOGY

Principals as managers of educational institutions, and indeed others carrying out a managerial role within the college, have to recognise that they live at a time when uncritical development of any institution or community service is unacceptable.

Perhaps it was acceptable in the less critical circumstances of the 1950s and 1960s, but during recent restrictions on growth and available resources there is a danger that we accept less than we believe to be best and hope for better things.

Assumptions and habits continue to survive from those less critical days. Fundamental to these is the confusion between teaching and learning which formed the basis of the third Cantor lecture to the Royal Society of Arts by Tyrrell Burgess in 1978 ... "(The theories of education) hold that learning takes place through the activity of the learner. Educational practice, however, implicitly assumes that learning takes place through the activity of the teacher ... Teachers present their material and the taught acquire and then reproduce it. Unfortunately, this almost universal practice among teachers flies in the face of what is almost universally agreed about learning ... there appear to be two kinds of need in the world, the need to learn and the need to teach. These two needs are at war; the one is incompatible with the other."

The principal must subject all such assumptions to careful scrutiny and manage those changes which will ensure that appropriate compromises are reached between the growing demand for FE on the one hand and the shortage of resources on the other.

Of course there are many tasks which the principal has in addition to the management of educational resources. He has to be the academic leader of his college; the leader towards the perceived and as yet unperceived objectives of the college. These objectives may involve the provision of FE opportunities of entirely new kinds. He has to represent the college and its needs to the governors and the local education authority and to render an account for its use of public funds. And that is by no means an exhaustive list!

But the principle's key task is the management of resources and the other tasks cannot be divorced from this key task.

J.M. Antia in *Education Administration*, the journal of the British Educational Administration Society, Vol.5. No.1, Autumn 1976, has given three dimensions of organisational performance:

(i) Effectiveness; "an institution can be said to be effective if it succeeds in accomplishing the purposes for which it exists."

(ii) Efficiency; "the relationship between the accomplishment of purpose and its cost."

(iii) Future capability; "those attributes of an organisation that enable it to define and meet the challenges it may have to face in the future."

What are the explicit agreed objectives of your college? What are the principal's objectives as a manager?

Without clearly understood objectives it is impossible to assess adequately the effectiveness of the college or its manager. Unfortunately, too much of the further education service has relied on implicit objectives such as simply to provide further education and to achieve examination results which satisfy advisory committees and governing bodies.

One objective which Stockport College accepted in the mid-1970s was to meet as much of a growing demand for further education as could reasonably be provided despite an Authority policy of nil growth in terms of accommodation and finance.

If colleges are to be effective and efficient, managers must have available to them an adequate base of information. A time of severe pressure on resources coupled with growing demand makes this base even more necessary. Education is being subjected to a more intense public scrutiny than in earlier years. We can no longer expect decisions of the highest quality to be made on a basis of intuition but rather on a basis of high quality information. It is not that colleges and departments lack information, it is often only too plentiful. But is the information of the right kind and is it organised in the best way to facilitate decisions and to satisfy the data requirements of external agencies?

A management information system is a system of collecting and organising information in order to help management (and external agencies) formulate the best decisions to solve the problems the college faces.

A common objection to MIS in an educational institution is the danager of misuse of the information. Usually the objectors are thinking of those outside the colleges. One member of a Coombe Lodge conference put it this way: his concern was "occasioned by the fact that the procedures (of a proposed MIS for colleges) are of such transparent simplicity that they will ultimately get into the hands of decision makers whose knowledge of education is slight, whose commitment to education is questionable and whose definition of resource effectiveness was arrived at without recourse to reflecting on the quality of the educational product and whether the product was educated like a human being or a battery hen".

This danger undoubtedly exists, but those whose attitudes are

unhelpful to educational advance are going to have more opportunity to criticise when information about a college's activity is sparse or hidden from public view. A college which has systematised its information about its effectiveness and efficiency will be better able to counter criticism and justify its activities.

The arguments for management information systems in colleges which I have been presenting may be summarised as follows:-

1. Public accountability: Colleges provide a service to the public and must be accountable to the public for that service. Our basic purpose, our effectiveness in achieving those purposes, and the efficiency with which we use resources made available to us, must be open to the local authority, which is required to secure the provision of further education in its area, and to the public at large.

2. Justification: The college has to be able to justify to the local authority the resources it needs. This can only be done on the basis of critical analysis of resource needs against educational objectives. The case presented must be as sound and well-reasoned as those for other aspects of public service which are funded, together with the education service, from resources which are essentially limited.

3. Effective management: A college can be effectively managed only if its managers know what the college is doing and are able to judge how well it is doing it. Lack of relevant information perpetuates inefficiency. If the way in which resources are being utilised is never questioned, a growth in demand must be met by additional resources or else the college must refuse to meet the demand.

4. Current pressures: Most colleges are experiencing an increased demand for further education, especially for non-advanced courses for the 16-19 age group. This must challenge us to deploy limited resources to better effect in terms of both the quality and quantity of the education and training we provide.

So much for reasons for the establishment of a management information system, but what will be the major components of such a system? What information do colleges need for effective management?

(a) Student inputs: Every college records personal details of each student. Enrolment data categorised by course, by grade of course, and by department or faculty

provides some measure of the work load of the college. Coupled with hours of attendance the student-hour is a common measure and a number of definitions of the full-time-equivalent student are in use. Enrolment data collected from year to year provide the major part of the identification of trends of demand.

(b) Resource inputs

(i) Teacher deployment: The way in which teaching staff are deployed in relation to students is measured by such parameters as average class size (ACS), student-staff ratio(SSR), etc. Fundamental to this aspect of resource utilisation is the need for a course file of unit documents, one for each course, which set out the resources of teaching hours required for the particular course group for all its directly taught activity.

(ii) Teacher utilisation: The effectiveness with which available teaching resources are used. This is expressed in another unit document, the individual teacher's timetable. Unfortunately, this document is rarely completed with the care and precision that its importance justifies.

(iii) Space utilisation: How effectively are the teaching spaces in the college used? It is strange that those working in a college imagine it to be much fuller than it really is. DES Design Note 12 *Space Utilisation in Universities and Polytechnics* (1974) showed this to be so and introduced the components of a space utilisation factor as the room frequency factor and the seat occupancy factor. Colleges need to manage teaching spaces to maximise these factors without loss of educational effectiveness. This can be done only by means of a detailed teaching space booking system applied at least to the general teaching spaces in which the best fit is achieved between class size and room capacity and the highest frequency of room usage obtained over the available hours in the day and the week.

(iv) Other resources: Although the revenue cost of other resources is usually small compared with teaching staff resources, an information system may also include support staff, educational materials

and equipment. The correlation between these resources and educational objectives may be less amenable to definition but it will be important to include them nevertheless.

(c) Students' Learning Process: This is an extremely important area in which information is necessary but not very easy to gather for a variety of reasons. Three aspects may be listed:-

(i) Value of the student's course - to the student and to his employer.

(ii) Performance of the teacher; staff appraisal is not a popular idea with teachers but self-appraisal is fundamental to a teacher's professional activity and linked to his assessment of student performance.

(iii) Performance of the student; all colleges record the progress of each student and take corrective action to ensure that as far as it may be in the teacher's power, each student progresses towards goals consistent with his aptitude and ability.

(d) Student outputs: quantitative output measures - success, completion and wastage rates - are commonly collected by colleges. It is, however, important that student performance records are used not only for reports to students' employers and governors, but also as indications of the "health" of the college, aspects of which may be susceptible to improvement by managerial action.

The quality of the output is far more difficult to assess,but most would agree that it is vitally important. Of course there is a connection, although difficult to define, between resource inputs and the quality of the educational experience.

A management information system has to serve a number of different purposes.Firstly, against a forecast of the probable student enrolments for a future year, the total resource requirements in terms of teacher hours, space, etc., is estimated and a total planned budget established.

Secondly, this plan is compared with the actual resources available and adjustments made, usually to the plan. Thirdly, when actual student enrolments are being made, the resource requirements are adjusted within the overall budget limits or enrolments themselves are controlled so that the resources and enrolments are matched.

The key to an effective mangement information system in a college is found in the course details file - a file in which

the major resource needs, primarily teacher inputs, are identified in a manner which brings them into clear focus with the perceived objectives of the course. This allows, indeed encourages, professional discussion justifying the resources being used or accepting the implications for teaching method of a reduction in direct teaching or an enlargement of the average class size.

I have tried to describe the thinking behind the introduction of a management information system in Stockport College of Technology. I conclude by summarising what I call the criteria for a successful management information system: it must be:-

1. As simple as possible, allowing easy access to important data and based throughout on a uniform set of definitions;
2. Unified, i.e. it must bring together into one system what is often a series of separate and overlapping data requests to departments;
3. Systematic, i.e. a planned system which is hierarchic, the primary data being summarised in various ways for different purposes with a progressive loss of detail;
4. Based on the course (or student learning environment);
5. Coherent - i.e. it should be self-checking within files and from one file to another;
6. Seen to be of value for the internal needs of all who manage within the college and for the easy supply of statistical data required by external agencies such as the LEA and DES.

RESOURCE MANAGEMENT IN A MIXED INSTITUTION

DR K. SWINHOE, DEPUTY PRINCIPAL, and
DR J. HARTLEY, SENIOR LECTURER, DEPARTMENT OF SCIENCE & MATHS,
OF DONCASTER METROPOLITAN INSTITUTE OF HIGHER EDUCATION

It has been reported[1] that a major review of staff/student ratios and costs in polytechnics and colleges is being carried out by a working party of DES and local government officers, one of whose main tasks will be to devise a new formula for counting student numbers. Point had been given to the exercise by the disclosure of a comparison of polytechnic costs carried out by polytechnic finance officers, and subsequently strongly criticised by polytechnic directors. One of the major difficulties mentioned has been devising a satisfactory means of allowing due weighting for part time students; another is connected with differing subject profiles.

A third problem arises when different levels of work are taken into account, it being generally argued that the more advanced work undertaken the greater the unit input necessary. Indeed, the existence of the polytechnics as advanced level institutions rests largely upon this viewpoint. Outside the polytechnics, however, there is in the public sector a number of institutions which have a significant but not a major amount of advanced work. In such institutions the problem of determining resource allocation to differing levels of work is accentuated, while the difficulties created by having large numbers of part time students and a wide mix of subjects also arise.

Doncaster Metropolitan Institute of Higher Education is one such institution. It was formed in 1976 by an amalgamation of two colleges of education, a large college of technology and a college of art. The new institute found itself with what could broadly be described as 2,500 full time students and 15,000 part time students. However, the part time students attended under a variety of modes, and even the full time students had varying modes of attendance. The level of work ranged from school link and work experience courses through City & Guilds, Ordinary National Certificates and Diplomas, Higher National Certificates and Diplomas, teacher education degree and post-graduate courses, with a host of courses leading to professional examinations at preliminary, intermediate and advanced levels. Within a very short time the academic board was seeing what the resource management problems were, and was facing critical questions, as the following quotation from one of its papers of the time shows:

"With the huge diversity of courses which the institute has, it becomes particularly urgent to find some means of comparing resource requirement and provision. How does one adjudicate, for example, between the claims of a day release group of engineering apprentices who require £200 to be spent on welding rods, as against a

similar amount required by a third year BEd group which wishes to make a film covering the activities of a school class? Or, to move into a much more expensive area, how does one assess relative staffing provision?"[2]

At the same time senior management of the institute were having difficulty in fully understanding the nature of the new amalgamation, both in its various parts and as any sort of single entity. For reasons other than those associated with resource management, the need was felt for some means of measuring and describing across the board and in a common language what the institute was about.

Senior management initially advocated the use of full time student equivalents as a basic unit of measurement. The formulae proposed were similar to those commonly used in polytechnics and universities; for example, a sandwich student would count as .9 of a full time student; a block release student as .5; a part time day student as .3 and so on. It was felt that these formulae were fairly widely established, simple to understand and apply, and could be used in negotiations with outside bodies, such as the CNAA, or in making comparisons for various purposes.

It soon became clear, however, there was wide feeling in the institute that such a method would be too crude if applied to the large variety of courses and modes of attendance which existed. There were in fact, 12 different modes of attendance,[3] and approximately 900 different courses. While it was accepted that the full time equivalent formulae may be the correct language to use with the outside world, because that was the language the outside world understood, alternative methods were needed for internal purposes.

The main stumbling block was that any formulae devised were not felt to take sufficient account of the different modes of attendance. Even the notion of a 'full time' student was unclear: a full time student on an art foundation course had a class contact of 40 hours per week, while a full time student in the same department taking the third year of a BEd course might have a class contact of 12 hours per week. Students on integrated courses run under Industrial Training Board schemes in some cases attended for 44 weeks of the year, compared with the "normal" institute year of 36 weeks. In part time courses, day release might involve in some cases 5½ hours of attendance, in others 6 hours, in others 6½; evening attendance might be for 1½, 2, 2½ or 3 hours. The range of possible attendance on short courses ran from 10 to 120 hours. The debate led inexorably to the conclusion that, short of having a host of formulae which would be very difficult to manage and which would still be subject to modifications to meet new forms, the basic unit of measurement should be hours of student attendance, so furnishing a striking example of what D.C. Spencer has apprehensively referred to as a seemingly inevitable tendency to make use of curricular hours.[4]

Spencer's apprehension arises partly from his view that curricular hours are an input rather than an output measurement, but also because they are determined intenally by college staff who have a vested interest in their increase. In Doncaster it has been accepted that hours of student attendance are not the appropriate measure of final output, which must have to do with course completions, examination successes and various forms of student self-improvement. However, they are a practicable measure of student activity, a point clearly demonstrated by Birch and Calvert in their development of a management information system using timetable analysis[5], and can be seen as at least a first stage towards comparing educational outputs. As for the fear that vested interest would increase the figures, this was thought in Doncaster to be no better founded than the fear that other forms of measurement, particularly full-time equivalents, were already used to serve the vested interest of those involved entirely or chiefly with full time students. It is interesting to note in this connection that Crispin has criticised student number orientated approaches to staffing allocations, which would presumably include counting curricular hours as we do, as possibly encouraging underprovision, by contrast with teaching commitment models, which might encourage overprovision[6].

The other main question to be raised was whether the possible hours of student attendance or actual hours of student attendance should be counted. The attraction of possible hours of student attendance was that it lent itself fairly readily to estimating future activity. If you know how many students you are likely to have on a course, then the possible hours of attendance are simply a multiple of that number and the timetabled hours. Moreover, particularly where the most expensive resource - that of staffing - is concerned, resources have to be provided on the assumption that full possible attendance will be achieved. If actual student hours of attendance are taken, then in estimating for the future a further assessment has to be made of the rate of attendance likely to be achieved by students. If in a particular class a rate of attendance of only 50 per cent of the possible hours is achieved, nevertheless a teacher has to be provided for that group as if the attendance were 100 per cent.

In spite of the disadvantages of taking actual student attendance, however, this method was chosen for two reasons, both having to do with resource control and monitoring. Firstly, it was felt that an estimate of possible student hours allowed for too much flexibility in the calculation, possible encouraging over-estimates. Secondly, actual student hours were in fact recorded for almost all the students, in attendance at the institute. This record was the basis of an auditable document connected with the calculation of Burnham points. There was therefore in existence a quite rigorous check on the accuracy of such figures. Moreover, because of their use in matters connected with conditions of service, the local authority is familiar with the calculation of actual student hours. In negotiations with officers this familiarity provides an important basis of confidence.

But perhaps the most important advantage in this particular institute in selecting actual student hours rather than a full time equivalent formulae was of a psychological nature. Most of the institute's work was not with full time students. To relate the rest of the work to that done with full time students appeared to many to be skewing the emphasis in the wrong direction. The needs of part time students are recognised as being in many respects different from and even more demanding than those of full time students. By selecting what could be regarded as a neutral form of basic measurement, any suggestion that part time students should be taken into account only to the extent to which they corresponded to full time students was avoided.

Using actual student hours of attendance as a basic unit of measurement then, the institute was able to embark on four things:

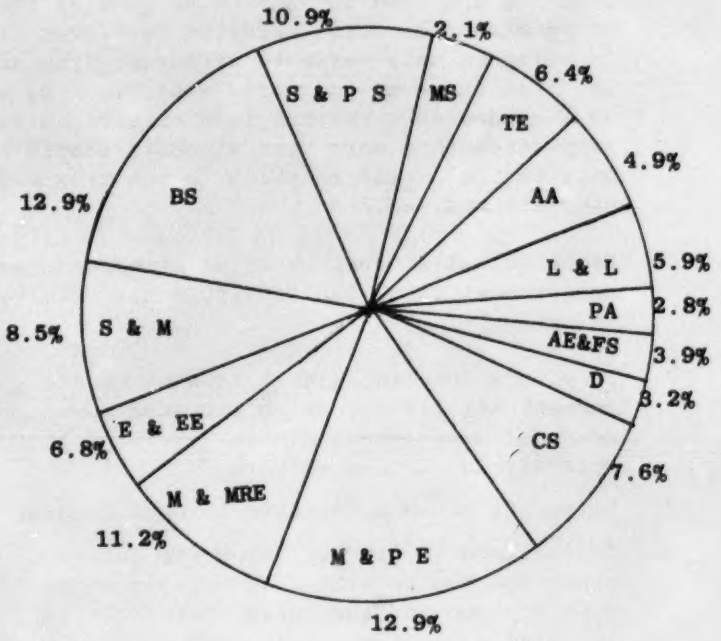
1. To give a concise, global account of its current activities, which provided some means of measurement of the levels of activity in various sectors;
2. To relate those activities to cost inputs;
3. To indicate in similar terms its future plans and the relationship between those future plans and the costs that might be incurred;
4. To begin to consider whether a more satisfactory basis for determining the allocation of resources might be made by refining the basic information now available.

On 1, the process of allowing members of the institute to understand better its total activity has begun through the demonstration to heads of departments through simple pi-charts of the distribution of work by a number of variables. For illustrative purposes some of these are given in Figures 1-3 (on pages 380 - 381), as follows:

Figure 1. Distribution of Actual Student Hours by Department.
Figure 2. Distribution of Actual Student Hours by Grade of Work.
Figure 3. Distribution of Actual Student Hours by Mode of Attendance.

The debate as to whether certain areas of work should be developed or diminished can now be given a new dimension by developing an accepted way of broadly assessing what is happening.

Figure 1: DISTRIBUTION OF ACTUAL STUDENT HOURS BY DEPARTMENT



KEY

AA	=	Academic Arts
AE&FS	=	Art Education and Foundation Studies
BS	=	Business Studies
CS	=	Construction Studies
D	=	Design
E&EE	=	Electrical and Electronic Engineering
L&L	=	Language & Literature
MS	=	Management Studies
M&PE	=	Mechanical and Production Engineering
M&MRE	=	Mining and Mineral Resources Engineering
PA	=	Performing Arts
S&M	=	Science and Mathematics
S&PS	=	Social and Personal Studies
TE	=	Teacher Education

Figure 2: DISTRIBUTION OF ACTUAL STUDENT HOURS BY GRADE OF WORK

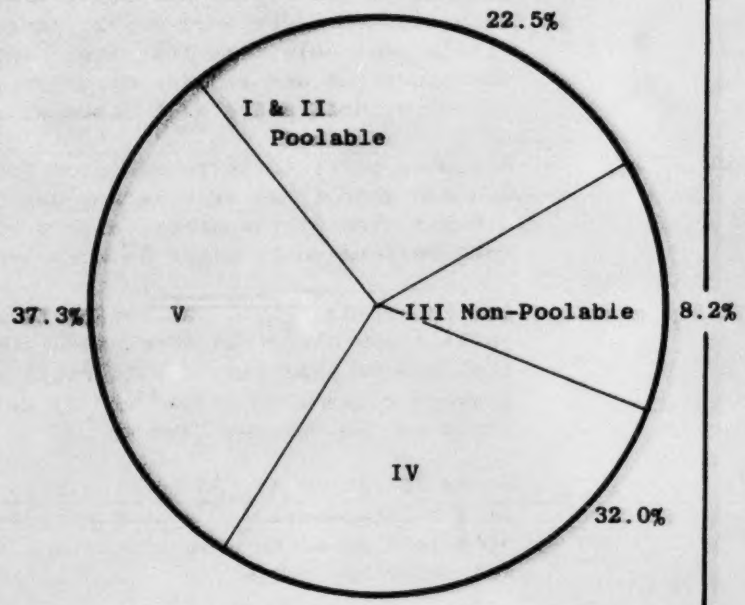
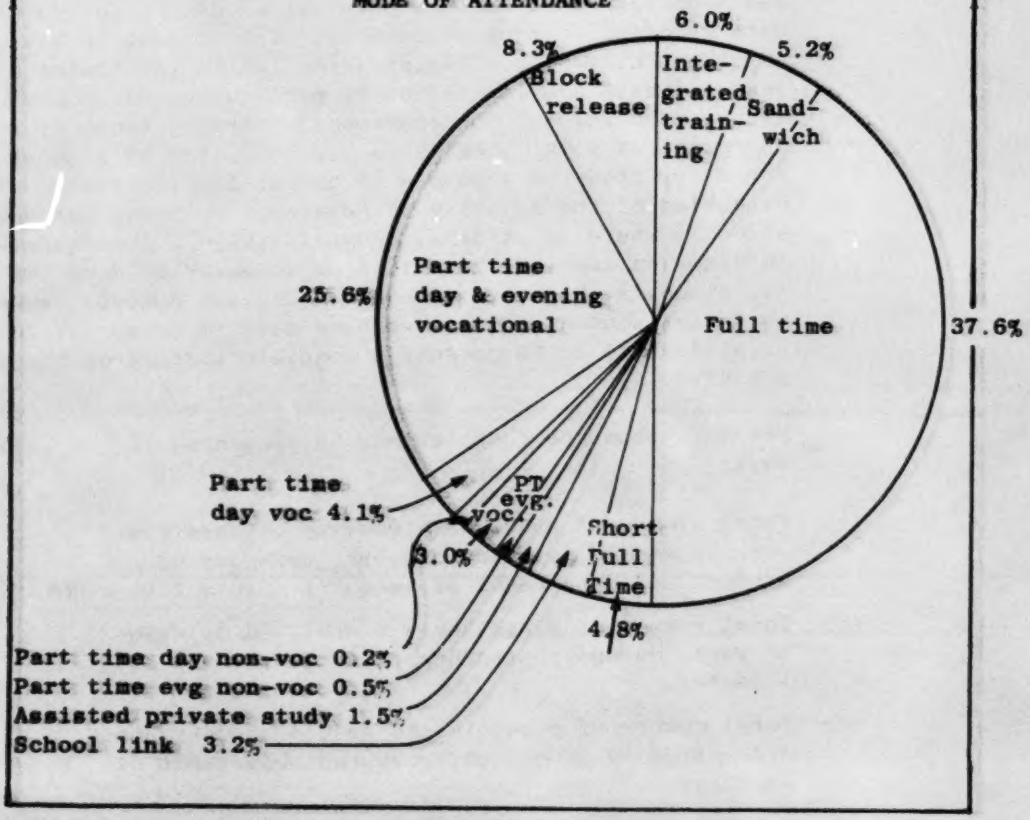


Figure 3: DISTRIBUTION OF ACTUAL STUDENT HOURS BY MODE OF ATTENDANCE



On 3, an academic development plan was produced for the next three years of the institute's life, and presented to the local authority. The local authority asked that the plan be re-submitted to cover a five-year period, but perhaps the most significant point was that local authority officers, both in the education and finance directorates, accepted the use of actual student hours as a basis of measurement[7].

But more pertinently to the question of resource allocation and management, an examination has also begun of the present distribution of resources, with a view to deciding whether more refined tools might be used over future allocations.

As a starting point, the ratio of actual student hours to total class hours has been calculated for each department (Table 1 on page 385). This ratio may be referred to as the average class size index[8] and is related to the student/staff ratio by the Delaney formula[9].

As an extension of the four points, further ratios suggested in the literature [8,10], or modifications based on these have been considered for the allocation of resources in ways which are described below.

At Doncaster student statistics from enrolments and registers are stored in the LEA computer. Access to the information that has been tabulated becomes possible as a consequence of the data relating to each student, as each student is assigned an enrolment number upon registration, while the course and subjects studies are identified by particular code numbers, which are in turn related to department, category (mode of attendance) and grade of work. Registers are completed by academic staff for every class of students taught at the institute, with the exception of the majority of sessions involving teacher training students where an informal count is taken. Consequently the information tabulated has this deficiency: it does not include all students that have attended courses. However, amendments to actual student hours have been made to cater for this group of student so as to present a complete picture of the institute's activity.

The data from the computer may be presented in the following ways:

(a) Total number of students attending classes that are classified by grade of work, category of student and department of lecturer (Table 2, page 386);

(b) Total number of class hours classified by grade of work, category of student and department of lecturer;

(c) Total number of possible and actual student hours classified by grade, category and department of lecturer;

(d) Total number of students per grade, category and department to which course is assigned (Table 3, page 387).

(e) Total number of courses and subjects classified by grade, category and department of course and department of lecturer.

A summary, for all departments, is illustrated in Table 4 on page 388.

These displays (two examples are given in Tables 2 and 3) conveniently illustrate the pattern of work and level of activity within a department. Consequently, this data is useful in assessing past performance. Classification of the statistics by department of lecturer and department of course enables servicing work between departments to be highlighted. Comparing the total student numbers in the management department (Tables 2 and 3) arranged in these two ways shows that 155 more students than those enrolled on courses accredited to this department were taught by management department staff during the academic session.

Closer examination of Tables 2 and 3 reveals that 84 students, attending sandwich courses at Burnham III poolable grade, came from outside the management department. The departments from which these students originated may be ascertained from the computer print out of the classification of all the courses and subjects taught in the management department, by grade and category. Hence the direction and magnitude of servicing within a department may be appreciated. Similarly, the number of courses run, the mode of attendance pattern and the grades of work taught in the department are more forcibly stated in this tabulated form.

In addition to the total class hours and the relationship with actual student hours, further information regarding staff and departmental budgets can be derived and may be employed with the computer tabulations of departmental activity in assessing past performance. Information concerning staff utilisation may be deduced from a comparison of the potential teaching capacity and the total class hours taught (Table 5 on page 389), although allowance must be made for the doubling up of classes, the work pattern during the academic year, and the degree of flexibility of teaching expertise. The ratios greater than one reflect the unpaid overtime work carried out by senior staff of some departments, which if included would augment the potential teaching capacity.

Staff utilisation is also reflected in the direct costs for academic staff. The major part of direct labour costs per annum, ie the full time academic teaching staff salaries, have been estimated from the establishment of the institute and the average salaries per grade. These are shown in Table 6 (page 390), where they are classified by department. The institute-governed staff costs per department are illustrated in Table 7 (page 391). From this the total direct staffing costs may be obtained from a summation of the full time and part time teachers' salaries, overtime and other teaching staff expenses. The total direct staff costs have been related to actual student hours in Table 8 (page 392) and these are augmented by the material and equipment costs to achieve the total direct unit cost for

each department. No attempt has been made to assign capital expenditure or identify opportunity costs, in common with other approaches to unit cost estimating in this field[11]. It is interesting to compare the marginal costing of staff with the absorption costing. The absorption costing has been determined by apportioning the indirect academic and non-teaching staff salaries and wages using appropriate bases, and these are shown with absorption unit costs in Table 9 (page 393).

The quantitative relationships that have been derived may also be applied to the future operation of a department. The monitoring and forecasting of resources can be achieved by the ratios and unit costs defined above.

After the registers are completed for an academic session, the various computer finds may be carried out to obtain the work profile of the department. At this stage the suggested ratios and quantitative methods may be applied to summarise the year's achievements. Following this assessment the projections for the next session (or beyond) may be attempted. From the average number of students attending classes (obtained from Table 4, on dividing the number of students attending classes (column 1) by the total number of subjects (column 2), the teaching and service work, and the envisaged number of courses, the possible student hours for the department may be calculated. In order to obtain a more realistic figure for the student volume expected the possible student hours may be amended to estimated 'actual' hours by employing the percentage attendance (Table 1). The estimated 'actual' student hours are a measure of the department's future commitments. How the resources match those commitments can be indicated by the quantitative methods already mentioned.

What is the new student/staff ratio after a consideration of the authorised remissions, the overtime hours, and the part time hours has been made? Is the department's staff under-or over-utilised? What are the academic staff costs? Are the material and equipment allocations sufficient? The derived relationships between staff, materials and money can answer these important questions for the head of a department. Naturally these forms of information create a picture of the work within the department which requires further clarification by the responsible people concerned. Nevertheless, the information can be particularly valuable in highlighting discrepancies and giving aid to decision making.

In order to explore the extent to which this data can be provided, relied upon and used in Doncaster, a working party on planning information systems has now been operating for six months. So far it appears to be successful in improving the accuracy of the data, in particular that related to the academic staff hours (class hours) owing to the changes in the conditions of service. The working party has, however, been more successful in identifying the limits beyond which the approaches to resource allocation,described above, cannot go than in broadening their application. Given a year's functioning it should be possible to see what progress has been made and at that stage a further account is proposed.

Table 1: STAFF RESOURCES : AVERAGE CLASS SIZE INDEX

Department	Average Class Size Index ($ASH/_{TSH}$)	% Student Attendance
Academic Arts	12.7	84(67)
Art Education & Foundation Studies	9.7	81(76)
Business Studies	13.6	78
Construction Studies	12.0	91
Design	6.2	83
Electrical & Electronic Engineering	12.6	81
Language & Literature	13.9	84(73)
Management Studies	10.2	85
Mechanical & Production Engineering	11.2	84
Mining & Mineral Resources Engineering	12.6	88
Performing Arts	10.2	97(86)
Science & Mathematics	11.2	80(73)
Social & Personal Studies	12.3	84
Teacher Education	18.7	100(85)
Institute Average	12.0	85.7

Notes:

1 ASH, Actual Student Hours

TCH, Total Class Hours

2 % Student Attendance = $\frac{\text{Actual Student Hours}}{\text{Possible Student Hours}}$

Figures in brackets computed with the exclusion of Teacher Training hours.

Table 2: DEPARTMENT OF MANAGEMENT STUDIES

Total number of students attending classes that are classified by grade, category and department of lecturer.

Category of Student \ Grade of Work	Burnham III Poolable	Burnham III	Burnham IV	Burnham V	Burnham I/II Poolable	TOTAL
Full time						
Sandwich	84				16	100
Block	50	13	11			74
Part time day		168		120		288
Part time day & evening	412	265	196		448	1321
Evening	22		22			44
Evening non-vocational						
Full time Integrated						
Link						
Short full time		257	251	72		
TOTAL	568	703	480	192	464	2407

Table 3: DEPARTMENT OF MANAGEMENT STUDIES

Total number of students per grade, category and department of course.

Category of Student / Grade of Work	Burnham III Poolable	Burnham III	Burnham IV	Burnham V	Burnham I/II Poolable	TOTAL
Full time						
Sandwich	0				0	0
Block	0	0	0			0
Part time day		176		120		296
Part time day and evening	428	265	204		448	1345
Evening	22		22			44
Evening non-vocational						
Full time integrated						
Link						
Short full time		257	251	59		567
TOTAL	450	698	477	179	448	2252

Table 4: SUMMARY OF STUDENT STATISTICS FOR DEPARTMENTS

Student Statistics / Department	Total number of students enrolled	No. of students attending classes classified by department lecturer	No. of courses/No. of subjects classified by department lecturer	Possible class hours classified by department lecturer	Possible student hours classified by department lecturer	Actual student hours classified by department lecturer	No. of students attending classes classified by department of course	No. of courses/No. of subjects classified by department of course
Academic Arts	743	1413	40/ 78	5430	101984 111445*	67990 111445*	1378	54/88
Art Education & Foundation Studies	1221	1595	85/ 111	8955	138937 36338*	105864 36338*	1628	92/111
Business Studies	2119	4980	120/ 282	34753	604688	472441	4615	124/260
Construction Studies	1258	4993	94/ 373	23088	304596	277784	5478	121/413
Design	379	737	55/ 107	19156	142012	117968	741	55/107
Electrical & Electronic Engineering	1009	4447	64/ 282	19750	305901	248399	4018	62/248
Language & Literature	621	1205	34/ 66	8910	152880 106844*	111044 106844*	1012	35/55
Management Studies	492	2407	37/ 181	7540	90622	77144	2283	38/169
Mechanical & Production Engineering	2061	8476	150/ 617	42195	561984	472993	8529	162/611
Mining & Mineral Resources Engineering	2024	7807	140/ 540	32351	462041	408697	8873	188/619
Performing Arts	336	353	16/ 25	1998	26332 79768*	22728 79768*	232	18/19
Science & Mathematics	1273	3375	92/ 244	19080	278086 106793*	202329 106793*	2114	96/159
Social & Personal Studies	2142	4652	146/ 317	32511	473062	398718	5366	171/361
Teacher Education	13	13	2/ 2	136	1031 234238*	873 234238*	16	3/3
TOTAL	15581	46453	1075/ 3223	255853	3644136 675426 4319562	2984972 675426 3660398	46453	1222/3223

* Computed student-hours for teacher training students

Table 5: STAFF UTILISATION : RATIO OF TOTAL CLASS HOURS TO POTENTIAL TEACHING CAPACITY

Department	Potential Teaching Capacity (PTC*)	Total Class Hours (TCH**)	TCH / PTC
Academic Arts	16,081	14,114	0.87
Art Education & Foundation Studies	15,054	14,656	0.97
Business Studies	32,634	34,753	1.06
Construction Studies	22,314	23,088	1.03
Design	13,988	19,156	1.37
Electrical & Electronic Engineering	21,339	19,750	0.93
Language & Literature	17,093	15,673	0.92
Management Studies	8,836	7,540	0.85
Mechanical & Production Engineering	44,643	42,195	0.95
Mining & Mineral Resources Engineering	28,648	32,351	1.13
Performing Arts	13,482	10,032	0.74
Science & Mathematics	26,165	27,570	1.05
Social and Personal Studies	34,151	32,511	0.95
Teacher Education	13,022	12,555	0.96

* Potential Teaching Capacity: summation of class contact hours maxima for all full time staff of various grades in a department, together with the hours of part time and overtime staffing which were used (authorised remission hours being deducted from contact hours for this exercise)

** Total Cass Hours: data from registrars which has been amended for teacher training hours where appropriate.

Table 6: FULL TIME TEACHING STAFF COSTS (ESTIMATE)*

Department	Grade of Staff				Total £
	PL	SL	LII	LI	
Academic Arts	20100	62700	22000	27300	132100
Art Education & Foundation Studies	-	34200	17600	23400	75200
Construction Studies	-	11400	30800	62400	104600
Business Studies	13400	17100	44000	93600	168100
Design	-	11400	13200	27300	51900
Electrical & Electronic Engineering	6700	34200	30800	58500	130200
Mining & Mineral Resources Engineering	20100	68400	57200	54600	200300
Performing Arts	26800	45600	17600	3900	93900
Science & Mathematics	20100	85500	39600	46800	192000
Language & Literature	20100	68400	17600	31200	137300
Management Studies	6700	17100	22000	15600	61400
Mechanical & Production Engineering	13400	34200	44000	148200	239800
Social and Personal Studies	6700	11400	30800	97500	146400
Teacher Education	53600	79800	13200	-	146600
TOTAL	207700	581400	400400	690300	1879800
Academic non-teaching staff (14 heads, 5 principals, 5 librarians, 1 publicity officer and 3 educational technology staff)					254882
TOTAL					2134682

* Excluding overtime payments, National Insurance, Superannuation and other employee's expenses

Average salaries per grade taken as:
LI £3900, LII £4400, SL £5700, PL £6700.

Table 7: INSTITUTE-GOVERNED STAFF COSTS

Department	F/T Teaching	P/T & Over-time*	Other Teaching Exp ⌀	Non-Teaching Academic+	Other Staff Costs++	Total Staff
Academic Arts	132100	3000	34478	18206	56952	244736
Art Education & Foundation Studies	75200	21600	29370	18206	45134	189510
Construction Studies	104600	16500	35755	18206	88168	263229
Business Studies	168100	42000	58740	18206	149951	436997
Design	51900	23000	24262	18206	37443	154810
Electrical & Electronic Engineering	130200	15800	38308	18206	78841	281355
Mining & Mineral Resources Engineering	200300	7600	54909	18206	129719	410734
Performing Arts	93900	20500	28093	18206	32532	193230
Science & Mathematics	192000	12000	53632	18206	98114	373952
Language & Literature	137300	5250	38308	18206	69158	268222
Management Studies	61400	7300	17877	18206	24485	129168
Mechanical & Production Engineering	239800	38000	72786	18206	150126	518918
Social & Personal Studies	146400	34500	60016	18206	126552	385674
Teacher Education	146600	-	33200	18206	74623	272629
TOTAL	1879800	246950	579734	254882	1161798	4123164

* P/T and overtime allocation;

\+ Non-teaching academic costs; apportioned equally to departments (adjusted to nearest integer)

⌀ Other teaching expenses; teachers' national insurance etc apportioned by FTE staff

++ Other staff costs eg caretakers, cleaners, administration, technicians, refectory, maintenance, apportioned by actual student-hours

Table 8: MARGINAL COSTING (ACTUAL STUDENT HOURS)

Department	Direct Staff Costs	Staff Cost/ SH	Materials & equip-ment	Materials & equip/ SH	Total Direct Cost/SH
Academic Arts	169578	0.95	10841	0.06	1.01
Art Education & Foundation Studies	126170	0.89	21304	0.15	1.04
Construction Studies	156855	0.56	28506	0.10	0.66
Business Studies	268840	0.57	14101	0.03	0.60
Design	99162	0.84	22403	0.19	1.03
Electrical & Electronic Engineering	184308	0.74	16452	0.07	0.81
Mining & Mineral Resources Engineering	262809	0.64	22289	0.05	0.69
Performing Arts	142493	1.39	11296	0.11	1.50
Science & Mathematics	257632	0.83	22896	0.07	0.90
Language & Literature	180858	0.83	15125	0.07	0.90
Management Studies	86477	1.12	5421	0.07	1.19
Mechanical & Production Engineering	350586	0.74	35405	0.07	0.81
Social & Personal Studies	240916	0.60	17551	0.04	0.64
Teacher Education	179800	0.76	14177	0.06	0.82
Institute	2706484	0.74	257767	0.07	0.81

Table 9: ABSORPTION COSTING

Department	Total Direct Costs	Overheads		Actual S.H.	Total Cost/ S.H.
		+Non Teaching Academic Staff	≠ Other		
Academic Arts	180419	18206	97303	179435	1.65
Art Education & Foundation Studies	147474	18206	77112	142202	1.71
Construction Studies	185361	18206	150635	177784	1.28
Business Studies	282941	18206	256193	472441	1.18
Design	121565	18206	63972	117968	1.73
Electrical & Electronic Engineering	200760	18206	134700	248399	1.42
Mining & Mineral Resources Engineering	285098	18206	221626	408697	1.28
Performing Arts	153789	18206	55582	102496	2.22
Science & Mathematics	280528	18206	167629	309122	1.51
Language & Literature	195983	18206	118155	217888	1.53
Management Studies	91898	18206	41833	77144	1.97
Mechanical & Production Engineering	383991	18206	256492	472993	1.40
Social & Personal Studies	258467	18206	216214	398718	1.24
Teacher Education	193977	18206	127495	235111	1.44
Institute	2964251	254882	1984941	3660398	1.42

+ Apportioned equally between departments

≠ Apportioned by actual student-hour

NOTES AND REFERENCES

1. *Times Higher Educational Supplement* October 13 1978.

2. DMIHE Academic Board Paper JAC 62/76 - November 1976.

3. The 12 modes of attendance are:

   Full-time; Sandwich; Integrated Training;
   Block Release; Part Time Day Vocational;
   Part Time Evening Vocational;
   Part Time Day and Evening Vocational;
   Part Time Day Non-Vocational;
   Part Time Evening Non-Vocational;
   School Link; Short Full Time;
   Assisted Private Study.

4. D.C. Spencer *The Management of Educational Output* - Coombe Lodge Information Bank Paper 1272, 1978.

5. D.W. Birch, J.R. Calvert. *The Development of a Management Information System for a College of Further Education* - Coombe Lodge Information Bank Paper 1364, 1979.

6. A. Crispin, 'Academic Staffing Schemes Reconsidered' - *Educational Administration Bulletin* Vol.3.No.2 Summer 1975, pp.12-26.

7. The Local Authority has now accepted the resource implications of the Academic Development Plan for the first financial year of its operation(1979-80).

8. N. Whittaker. *The Allocation of Resources and the Monitoring of their use.* Coombe Lodge Report Vol.11.No.11.

9. *Assessment of Curricular Activity and Utilisation of Staff Resources in Polytechnics and Colleges of Further Education.* Councils and Education Press,1972.

10. J.A. Bottomley, et al. *Costs and Potential Economies* Centre for Educational Research and Innovation (CERI) Organisation for Economic Co-operation and Development (OECD), 1972,

11. See, e.g. D.W. Birch, J.R. Calvert and J. Sizer, "A Note on Costing the Teaching Activity in Higher Education," *Higher Education* 7 (1977) pp.67-74.

COMPUTER ASSISTED TIME-TABLE DEVELOPMENT AND ANALYSIS

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This paper describes the use of a mini-computer to assist in departmental time-tabling and resource allocation using the programe TRAMP (Time-table Recording, Analysis and Management Program) developed at Tottenham College of Technology.

In 1977, Tottenham College of Technology purchased a mini-computer system to assist in the teaching of programming and other computer-related topics. This system proved flexible and powerful enough to be used for departmental administration as well as in its primary function as a teaching aid. The major development in this area has been in a suite of programs to help with time-tabling operations. At present this is in use in just one department but the programs were designed to handle time-tables for the whole college.

GENERAL DESIGN CONSIDERATIONS

The systems design was constrained by the availability of equipment and staff and the nature of the time-table.

1. The Computer System (see Appendix on page 400)

This is a time-sharing system supporting one-line terminals. The only form of input is through these terminals. File storage is provided by magnetic discs.

2. Staff

This is limited to a technician who spends half his time assisting with computer operations. No relief in contact hours is available to any of the lecturing staff.

3. Time-Table Characteristics

Courses are organised on a fairly rigid structure. A student does not have a free choice of subjects but is required to select a suitable course from those on offer. This restriction makes the time-tabler's job much easier. Nearly all classes start on the hour so they may be represented by 12 time-slots per day. Some courses have a lecture-tutorial structure where the students are sometimes split into smaller groups and sometimes combined into large groups. These large groups may contain students from more than one course. Most courses run for the whole of the college year, giving a stable time-tabling requirement. Other courses have a block release or sandwich structure with periods of industrial training. These involve substantial time-table changes several times a year.

These constraints had the following main effects on the design:

1. The programs had to be easy to run and give plenty of help to the user, little time being available for assistance from the computer staff.
2. The programs had to pick up the information they needed from the user, no keyboard operators being available.
3. No attempt could be made to write programs to create or optimise time-tables as time was not available for the programming effort involved.
4. It was necessary to enable the programs to create and access a series of files so that time-tables for the whole year could be planned ahead.
5. Facilities for combining groups had to be incorporated.

COSTS AND BENEFITS

In order to use TRAMP the user has to find a free terminal, master the keyboard layout, log into the time-sharing system, run the correct program, identify the correct time-table file and then use the options within the programe to good effect. Although these operations are not difficult, the benefits have to be fairly substantial in order to persuade a senior member of staff that it is worth making the effort. The main benefits are listed below. In our experience they are worthwhile.

1. Inconsistencies are signalled and other help is given during time-tabling.
2. Time-tables for any lecturer, course or room can be quickly retrieved and displayed.
3. A print run can be initiated of individual time-tables (so that every lecturer and student can have one).
4. A master time-table can be printed for the whole department.
5. A space utilisation analysis can be made.

There is no direct cost incurred for computer time, this being available when not required by programming classes.

PROGRAM DESIGN PHILOSOPHY

The input of time-table data is done via on-line visual display units. The programs are "menu driven", that is at each stage the user is presented with a list of choices and must select one. One of these choices is always "HELP". At every stage TRAMP asks for information, suggesting an answer.

This system of menus and defaults has proved a powerful method

of guiding the inexperienced user through the pathways of the program logic.

SECURITY

By its nature a time-sharing system causes problems of security. This is because hundreds of users (mostly students) have access to the computer and its file storage devices. For this reason time-sharing systems have built-in safeguards to prevent unauthorised access to files. This is done by a system of account codes, protection codes and passwords. Using these systems level safeguards (others are built into the TRAMP programms) we can ensure that the time-table files are protected.

In order to make changes in the time-table file it is necessary to be on the TRAMP acoount (this requires knowledge of the account code and password) and to give the appropriate password for the department to TRAMP. This ensures that unauthorised persons do not make changes to the time-tables. Having given the password for his department the user is allowed to make changes to the time-tables of his own lecturers (all entries are made through the lecturers' time-tables). Because of servicing requirements, courses and rooms belonging to another department may have to be assigned to these lecturers. This is allowed.

Reading the file is another matter however. It is felt that there is no reason why the time-table file should not be freely available for anyone (including students) to read. Consequently "read" access is available to anyone with an account. All users have to do is log into their account and type "TRAMP". The program will run and allow them to read any time-table file. They can also use any other facilities of TRAMP that do not involve changing the file.

PRELIMINARY OPERATIONS

Before any time-tables are entered the user must inform TRAMP of the names of all lecturers, courses, rooms and subjects and give the following additional information:

1. Department (each lecturer, course and room)
2. Size (each course and room)
3. Group Number (each lecturer, course and room)
4. Splits (applies to some courses)

These details can be changed at a later date if necessary. Indeed this is essential in the case of course sizes which can usually only be guessed at when the time-table is prepared. These requirements are explained separately below.

DEPARTMENT

TRAMP is able to maintain a single time-table file for the whole college. This is desirable because although departments are largely autonomous there is a certain amount of interaction due to servicing, room sharing etc. Each lecturer,

course and room has an associated department number, so that TRAMP can deal satisfactorily, with, for example, a lecturer servicing a course from another department in a room borrowed from a third.

On entry, TRAMP requests the department name and asks for a password associated with the department. If the user cannot give the password then he is allowed to read from the file but cannot make any changes to it. During time-tabling operations the time-tables of other departments are normally hidden. For example if the user requests a list of rooms available at a certain time, TRAMP will list only the rooms in his own department unless he specifically requests a list for all departments.

SIZE

Sizes are given for courses and rooms so that:

1. A warning can be given if a class is too big for a room;

2. A space utilisation analysis can be made.

GROUP NUMBER

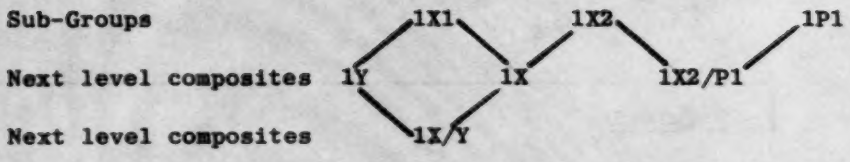
A group number can be associated with any lecturer, course or room. This 3-digit number can be structured at the discretion of the time-tabler. For example in the case of lecturers he could use the first digit to represent a section within the department, the second digit the grade, and the third the subject area. In all the TRAMP analysis routines the user is asked for the group number so that, for example, the usage of a particular group of lecturers can be requested. What is more, "wild cards" are allowed in group numbers so that the user can specify a group of groups. Thus if he gives the group number as *3*, TRAMP will pick out all groups with a middle digit of 3.

This simple idea gives considerable flexibility to the time-tabler in assigning characteristics to entries and using these characteristics to extract information.

SPLITS

This facility was put in to deal with the problem of split (or combined) courses. It is best explained with an example.

Suppose groups 1X1 and 1X2 combine together to form another group 1X 1X/Y. 1X1 and 1X2 are sub-groups of 1X while 1X is itself a sub-group of 1X/Y. If TRAMP is told about these combinations, whenever a time-table for 1X is printed, then at times when they are free of their own time-table, a search is made through the composite groups (1X and 1X/Y) and a time-table entry picked up from them if they are assigned. There can be more than one composite at each level so that situations like that shown on the following page can be accommodated.



Situations like this do occur in practice even with the rather rigid course structure at Tottenham. When the time-tables for sub-groups are printed, TRAMP consults the time-tables of all the composite groups and includes entries from them. A special marker is printed on the time-table to indicate that the entry has been picked up from a composite group.

This facility applies to rooms and lecturers too and is occasionally useful in these cases. For example, in the case of lecturers, one could cope with overtime by creating an overtime time-table, making the normal hours time-table a sub-entry for it. Thus in the analysis we can keep the overtime hours separate but still give the lecturer an accurate time-table with the overtime hours marked.

MAIN MENU

On entry, TRAMP prints a list of options and the user has to select one. These are:

READ
WRITE
USAGE
AVAILABILITY
SPLIT
ADD
ALTER
CLEAN
OUTPUT
LIST
PRINT
MASTER
DEPARTMENT
CHANGE
EXIT
HELP

READ

This option allows the user to display the time-table for any lecturer, course or room on his terminal or obtain a hard copy on the printer. Figure 1 (on page) shows an example time-table for a lecturer. Each time-table entry of a lecturer's time-table consists of three lines. The first is the name of the class being taught, the second is the room and the third is the subject.

```
**********************************************************************************
        ** TRAMP ** Tottenham College Timetable Program. Version 4B
**********************************************************************************
          Timetable for Lecturer D.WICKHAM in Dept: DEBUG Group 21
     9.00 10.00 11.00 12.00  1.00  2.00  3.00  4.00  5.00  6.00  7.00  8.00
     :
Mon:1Y    ..   1Y    ..    ..    2Y    2Y    2Y    ..    ..    ..    ..
   :RM2   ..   RM2   ..    ..    RM1   RM1   RM1   ..    ..    ..    ..
   :MATHS ..   MATHS ..    ..    COMP  COMP  COMP  ..    ..    ..    ..
     :
Tue:..    1X   2Y    ..    ..    ..    ..    ..    ..    ..    ..    ..
   :..    RM1  RM2   ..    ..    ..    ..    ..    ..    ..    ..    ..
   :..    MATHS COMP ..    ..    ..    ..    ..    ..    ..    ..    ..
     :
Wed:..    ..   2X    2X    ..    1X    1X    ..    ..    ..    ..    ..
   :..    ..   RM2   RM2   ..    RM2   RM2   ..    ..    ..    ..    ..
   :..    ..   COMP  COMP  ..    MATHS MATHS ..    ..    ..    ..    ..
     :
Thu:..    ..   1Y    ..    ..    1X    1X    ..    ..    ..    ..    ..
   :..    ..   RM2   ..    ..    RM0   RM0   ..    ..    ..    ..    ..
   :..    ..   MATHS ..    ..    COMP  COMP  ..    ..    ..    ..    ..
     :
Fri:1X    1Y   1Y    2X    ..    ..    ..    ..    ..    ..    ..    ..
   :RM2   RM0  RM0   RM2   ..    ..    ..    ..    ..    ..    ..    ..
   :COMP  COMP COMP  COMP  ..    ..    ..    ..    ..    ..    ..    ..
     :
**********************************************************************************
   Taken from file TRAMP: SEP79.VIR on 05-Aug-79 at 10:14 PM
```

Figure 1

WRITE

This is used to write a lecturer's time-table. When this option is entered a menu is displayed giving the facilities available. Briefly, these include commands for moving around the time-table from hour to hour and day to day. When the appropriate place is reached entries may be added or deleted. Any clashes are picked up, TRAMP refusing to make the entry.

To make a time-table entry the user gets to the appropriate time-slot and gives the course name, room name and subject for the class in question. TRAMP allows the entry if:

1. It recognises the course, room and subject names;
2. The course and room are free;
3. The user has "write" privileges to the files.

No facility exists for entering the course or room time-tables as these are automatically generated from the lecturers' time-tables.

USAGE

This prints the number of hours assigned to any (or specified groups of) lecturers, courses or rooms.

AVAILABILITY

A lecturer, course or room is available if not scheduled for a particular time. This routine checks on availability for a single time-slot or contiguous time-slots. It prints out a list of the available resources. The user may request only entries from a certain group (or group of groups using wild cards) to be listed. Thus it is possible, for example, to get a list of all rooms of type "laboratory" that are available on Monday afternoon from 2:00 to 4:00. This assumes that the group number has been used to classify the laboratories as such.

SPLIT

This enables the user to create or delete links between sub-groups and composites.

ADD

This is used to add a new lecturer, course, room or subject name together with their characteristics. It is used as part of the initial procedures to create the entries.

ALTER

This is used to make changes to the name or other characteristics of an entry specified previously.

LIST

This is used to print the names and other characteristics of

specified groups of lecturers, courses, rooms or subjects.

PRINT

This is used to obtain hard copies of sets of time-tables.

MASTER

The master time-table contains all, or specified groups of entries displayed day by day. An up-to-date copy of this master time-table would normally reside in the head of department's office and other copies in the staff-rooms.

DEPARTMENT

This is used to change to another department. TRAMP asks for the password for the new department and denies write access if it cannot be given.

CHANGE

This is used to change a password. It can only be used if the user had previously given the correct password when entering the department.

If the user does not have write access because he could not give the password then WRITE, SPLIT, ADD, ALTER, CLEAN and CHANGE are not allowed.

SPACE UTILISATION ANALYSIS

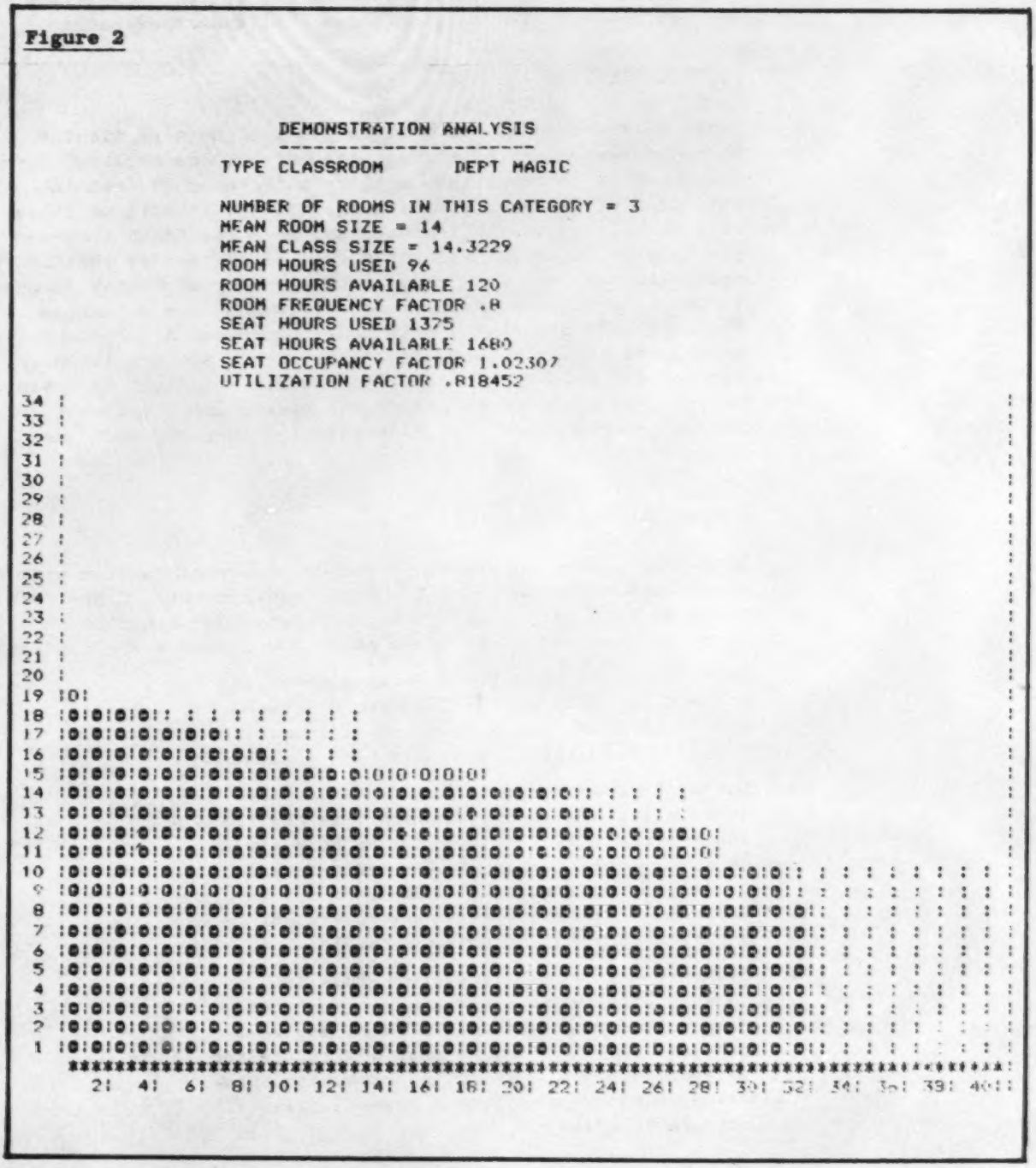
The main products of space utilisation programs are graphs and figures for the utilisation of individual rooms and groups of rooms (grouped by type and site). The source data for this analysis consists of:

1. The size of each room.
2. The number of students present at each period.
3. Classification of rooms by type and site.

This information is contained in TRAMP files and can be extracted and used as input to the space utilisation programs.

Figure 2 (on page 403) shows the output from one of these programs. The figures at the top give a precise summary of the usage of a group of rooms. The utilisation graph shows how the classes scheduled for these rooms compare in size with the room sizes. The rooms are lined up in order of size from the left hand side to give a room envelope marked by colons (:).The class sizes are similarly arranged to give a class envelope marked by circles (O). If the class envelope is completely within the room envelope then the classes will theoretically fit into the group of rooms. In a perfect fit each colon superimposes on each circle so that every entry has the symbol ⊙ . Any circles without colons show classes too big for available rooms. Any colons without circles show room space not used.

Figure 2


DEMONSTRATION ANALYSIS
TYPE CLASSROOM DEPT MAGIC
NUMBER OF ROOMS IN THIS CATEGORY = 3
MEAN ROOM SIZE = 14
MEAN CLASS SIZE = 14.3229
ROOM HOURS USED 96
ROOM HOURS AVAILABLE 120
ROOM FREQUENCY FACTOR .8
SEAT HOURS USED 1375
SEAT HOURS AVAILABLE 1680
SEAT OCCUPANCY FACTOR 1.02307
UTILIZATION FACTOR .818452
2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40

The vertical scale shows sizes of rooms or classes. The horizontal scale shows the number of hours each size occurs scaled to a standard week of 40 hours. If there are 'x' rooms in a group then the hours given on the horizontal axis must be multiplied by 'x' to give the actual number of hours.

PORTABILITY

TRAMP is tuned to the facilities provided by a particular computer system and to the requirements of one college. Given that most FE colleges have similar structures and run the same kind of courses, the main obstacle to installing it in another college is the computer system. The TRAMP programs are written in BASIC+ using the full facilities of the RSTS/E operating system. They would not run under any other computer system without being completely rewritten. The coding is, however, well structured with many comments. A competent programmer should be able to convert it to another language without too much difficulty. In practice it might be better to take the basic ideas behind the system and use them to construct programs tuned to the particular computer and time-table structure.

FUTURE DEVELOPMENTS

TRAMP has tended to grow in a rather piecemeal fashion with bits and pieces added on to suit users' requirements. Other developments of this nature are likely. Apart from this fine tuning there are several areas where major developments are desirable:

1. At present the creative work is done by the human time-tabler. It would make his task easier if TRAMP could generate an initial partial time-table given a set of constraints.
2. During time-table development the user is given a certain amount of help with the USAGE and AVAILABILITY routines. More help could be given; for example, TRAMP could be asked to search for a suitable time-slot for an entry indicating how other entries might be shuffled to make the entry possible.
3. TRAMP is a stand-alone system. This is because other administration (e.g. student records) is done centrally. There may be a move in the future to do more administration on the college computer, in which case TRAMP would be integrated into a general college management system.

These major developments would require extra resources in terms of staffing and equipment. In the present financial climate there seems little prospect of these being available in the near future.

CONCLUSIONS

The stimulus to writing the TRAMP programs was to demonstrate that the new computer was not just an expensive toy but could really do something useful. The main aim was to produce accurate, up-to-date time-tables quickly. It is now apparent that the system has implications beyond the original aims. The information contained in the TRAMP files can be used for more than the production of time-tables. The data in the files can be analysed in a variety of ways to determine the use of rooms and teaching staff. This analysis would give a fair indication of how well a college or department manages its resources.

ACKNOWLEDGEMENTS

I should like to acknowledge the help given by Dennis Ellis, computing technician at Tottenham College of Technology, who did most of the programming and contributed many ideas to TRAMP.

APPENDIX

THE COMPUTER SYSTEM

PROCESSOR

Digital Equipment Corporation PDP11/34 with 112 KW of memory and interfaces for 16 terminals.

FILE STORAGE DEVICES

Two cartridge disc drives (RKO5j) each having a capacity of 2.4 MB.

TERMINALS

A mixture of various makes of VDU each displaying 24 lines of 80 characters.

PRINTER

Dot matrix printer (LA 180) printing 180 ch/s on continuous stationery.

SOFTWARE

RSTS/E Ver 6C operating system. All programs written in BASIC+.

THE DEVELOPMENT OF MANAGEMENT INFORMATION SYSTEMS

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This brief report outlines North East London Polytechnic (NELP) developments over the period April 1974 to December 1978. The perspective is both from the view of the professional administrator (as registrar to the polytechnic - June 1976) and from the information systems head (as head of the management information centre and reader in management information systems from June 1976 to December 1978).

From the outset the problems were approached both from a practical management and administrative perspectives level, and from the research viewpoint. Little published material was available, except major work carried out in the United States at the National Centre for Higher Education Management Systems (NCHEMS) at Boulder, Colorado. It was felt that experience generated by development at NELP would be of considerable value to the educational community.

While the general approaches used at NCHEMS were very valuable, particularly the development of the data element dictionary (DEC), it was felt that a general approach should be adopted to the problems faced by UK further and higher education institutions by providing a practical NELP system which could form the basis for a generalised model for all FE/HE institution problems.

THE DEVELOPMENT OF THE MANAGEMENT INFORMATION CENTRE

In December 1976, the Management Information Centre (MIC) was formed to co-ordinate all aspects of information management in the institutions. Almost from the designation of the institution, there was a generally held belief by most senior management that there should be a consistent approach to all aspects of administration, management and planning, both in response to internally generated problems and externally generated demands. In the early 70s this policy resulted in a number of initiatives both by academics and administrators. Tentative steps were taken to establish a computer based records system in the registrar's division. An initial planning model was developed to establish five-year forecasts by a planning assistant working for the director. During this period systems and programming support were provided by staff in the computer centre. Attempts were made to integrate the information process into the general decision process within the institution with limited success.

TERMS OF REFERENCE FOR THE CENTRE

The terms of reference outlined below indicate the centre's broad philosophy:

- Develop computerised operational administrative systems to aid efficient running and management of the polytechnic.
- Provide effective data and statistics on all major resource areas within the polytechnic.
- Carry out research in the areas of educational management information systems, data base management, construction of computer based models of educational institutions for resource and academic planning usage forecasting techniques and the development of appropriate software packages.
- Liaise with other centres in the UK, Europe and America to exchange information and basic research findings.
- Liaise with faculties within the polytechnic working on the academic fields closely associated with the terms of reference.
- Use the expertise developed by the centre for teaching, seminars, postgraduate and undergraduate student research projects, together with in-course construction where relevant.
- Make developments in this area available to other institutions and act as consultants to other institutions.

STAFFING AND SYSTEMS RESOURCES ALLOCATED TO THE CENTRE

With the development of the centre, a number of staff was brought together to form three distinct but highly integrated functions relevant to the management of the information process function. These functions are illustrated in their functional form in Figure 1. Figures 2 and 3 illustrate their place within the overall organisation.

Figure 1

FUNCTIONS WITHIN THE CENTRE

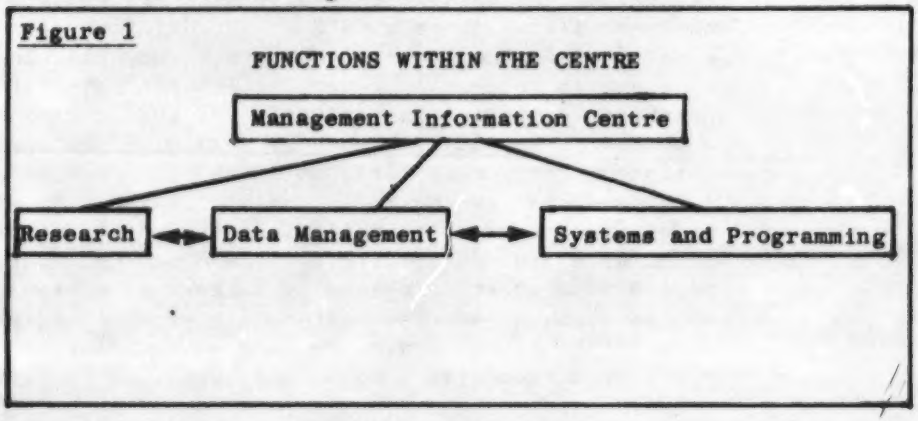


Figure 2

POSITION WITHIN THE ORGANISATION (Stage 1)

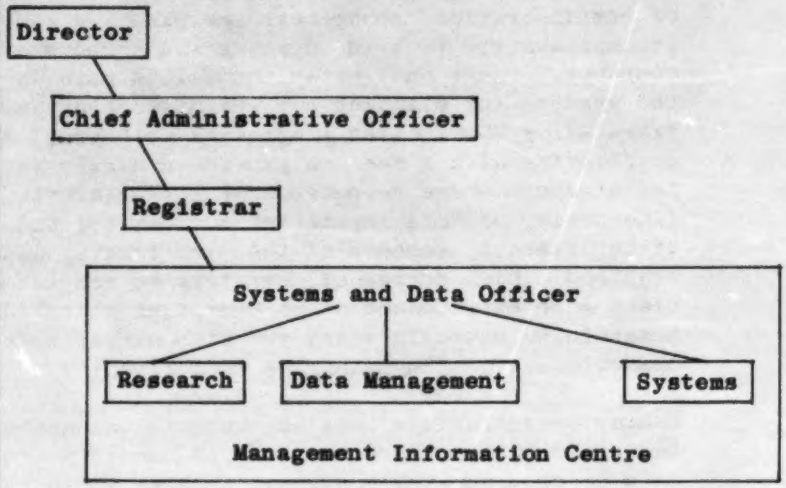
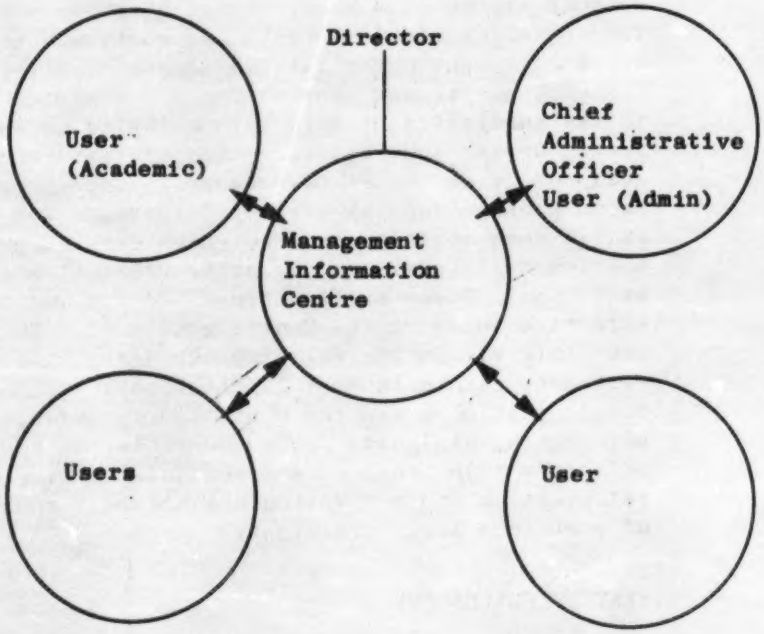


Figure 3

Stage 2 DEVELOPMENT - AN INDEPENDENT POSITION



STAFFING

As a general policy it was appropriate that the Centre should develop its own systems and programming expertise. Prior to the development of the Centre, careful analysis of the needs of administration, amangement and planning indicated a basic imcompatability with the demands and structure of the academic computer. These manifested themselves both in the nature of the systems for planning and administration, i.e. large data files using COBOL based programmes with problems of security conflicting with a need to provide a highly interactive service for students where response time was critical. The need for fine timing of data inputs and outputs for committees, heads of departments, members of the directorate, and external bodies required a high degree of certainty to run success. If problems were experienced on an overnight batch run, it was not possible to schedule a day run without severely affecting the academic use of the mainframe (ICL 1904S).

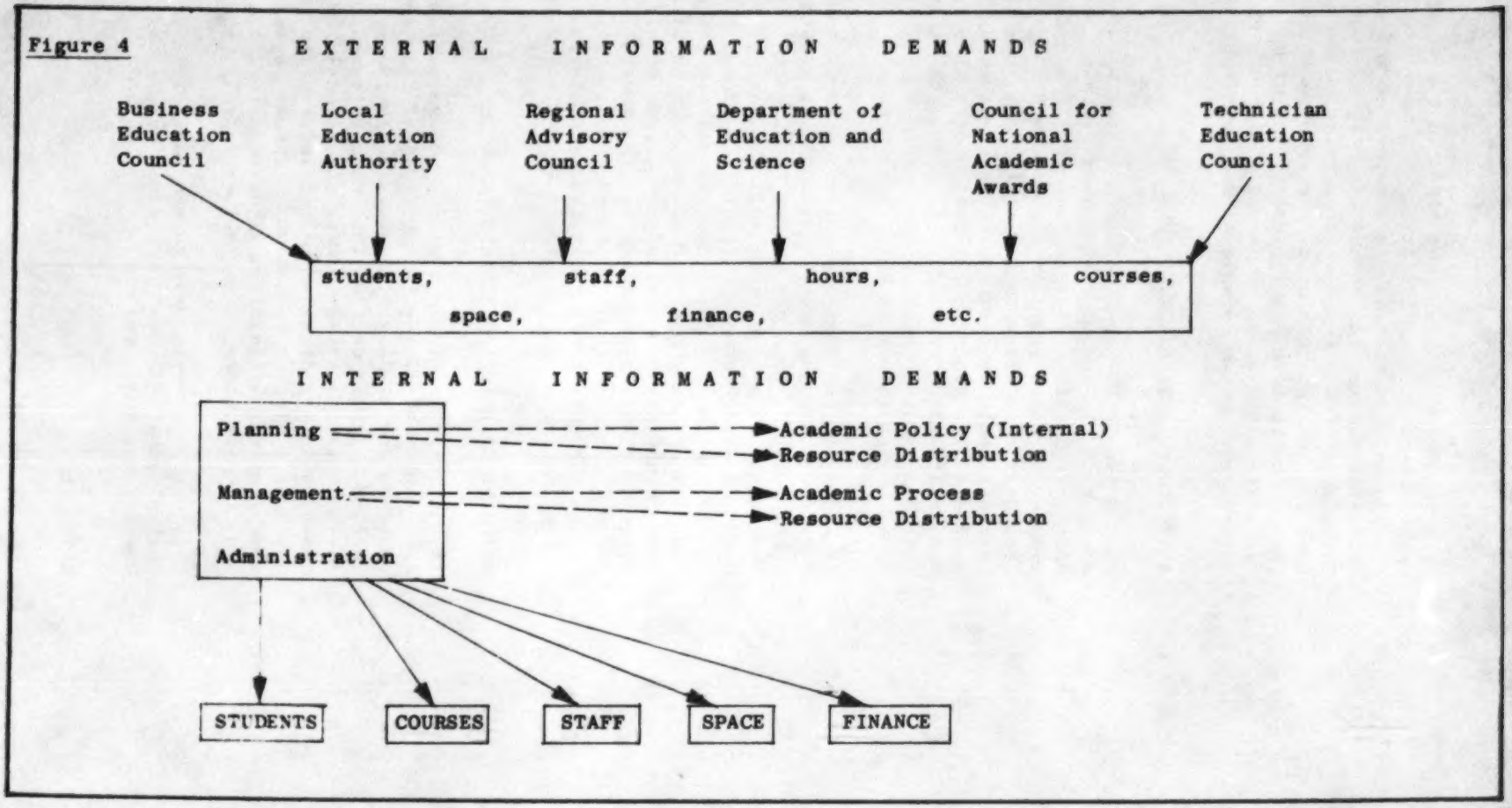
Taking these factors into account, it was necessary to develop dedicated COBOL programmes able to handle standard business data processing problems (this problem would not have arisen with readily available software). From the outset, recruitment of systems staff was extremely difficult - a phenomenon experienced by most public sector bodies. A considerable amount of in-house training was necessary as experienced staff were not attracted by the salary levels offered.

The same problems were not apparent in the Data Management Section, a section dedicated to the control of all inputs and outputs at the data base. These staff were mainly recruited from existing clerical posts and most had little or no experience of computing or data management. A vigorous in-house training policy was adopted for all staff to develop expertise in the submission of data into existing files, liaison with users' areas, and the extraction of lists and complex statistical analyses using the FIND2 package (a sophisticated interrogations package used as a general approach for many data outputs). Skills were quickly mastered which created promotional opportunities not experienced by other clerical staff in the institution. These staff represented the most consistent and effective resource the Centre generated. This was a resource available within the existing administrative structure (and certainly exists in most institutions). The training and development plan was the most important factor in this area, although by assigning, where possible, each data management officer a file area, it was possible to give considerable job satisfaction and motivation not normally found in this area of work in a large organisation.

SYSTEMS PHILOSOPHY

The Centre determined that they would work to the general educational model outlined in Figure 4 on page 411. Before detailing specific developments in the key areas outlined it is worth indicating the major systems problem that is likely to face institutions currently developing data base systems.

Figure 4


EXTERNAL INFORMATION DEMANDS
Business Education Council
Local Education Authority
Regional Advisory Council
Department of Education and Science
Council for National Academic Awards
Technician Education Council
students,
staff,
hours,
courses,
space,
finance,
etc.
INTERNAL INFORMATION DEMANDS
Planning
Management
Administration
Academic Policy (Internal)
Resource Distribution
Academic Process
Resource Distribution
STUDENTS
COURSES
STAFF
SPACE
FINANCE

411

This problem relates to the historical development in the organisation of computer files. In many cases conversion to a computer data base has been generated and carried out by enthusiasts committed to the advantages of computerisation. This has led in some cases to limited ad hoc systems which have created independent file development. The situation facing the Centre in 1976 was typical - that of having to keep existing systems operating while developing an integrated approach to create a system capable of use into the 1990s.

A STRATEGIC SYSTEMS OBJECTIVE

The Centre determined that the strategic objective was to develop at the end of a five year planning period an Integrated Data Base System (IDBS) able to meet the needs of the institution at an operational, management and planning level, and the demands for information and statistics from external bodies. This strategic objective had been arrived at from careful analysis of demands on the Centre. It also reflected a solution that would last and would enable the institution to concentrate valuable manpower resources on higher level work than would be possible with the manual system.

It is clear from analysis of demand for information that the last few years has seen an exponential growth in information and operational systems needed for internal management. This was caused by a combination of factors, not least of which has been the severe economic conditions since 1974. Demands within the institution for a more formalised planning and information system to cope with problems created by such pressures have necessitated a much higher degree of sophistication in academic planning and resource distribution. There seems no reason to expect this to change over the next five to ten years. Indeed there is every indication that formal planning will become an integral part of all academic institutions.

MATCHING CONFLICTING SYSTEMS PROBLEMS

It was not possible to simply stop one system in favour of an IDMS approach. The existing isolated file approach had to continue for at least two years while the switch over was made to IDMS. It was decided that no development would take place in the existing system except for essential maintenance and where mandatory demands for new information were created. Critical decisions were made on manual collection, although in almost every case additional systems work was incurred on the old file structure, thus further reducing the new system effort.

This existing system was to run until 1981/82 with the hope that the new IDMS would be tested over a trail dual period and operational from 1983.

HARDWARE

With the development of computer based systems, the hardware was that provided for the academic community. A number of problems arose which were difficult to rationalise within the

two systems. Strict security, planning availability, programme testing and development, large store and disc space requirements, specialised software, could not be rationalised in the single machine.

During 1977/78 a number of significant hardware enhancements took place; firstly with the acquisition of a dedicated terminal, at an immediate stage with an ICL7502, and finally the purchase of ICL2903 stand-alone machine, which eventually solved this problem.

INTEGRATED FILE AREAS

It was not possible to integrate properly the file areas developed, certainly not in the accepted sense of an integrated or relational data base approach. Thus file area developments were sometimes carried out in isolation of other file areas. However, this should not detract from important development work that occurred.

THE STUDENT/COURSE FILE

This file had received most attention over the years. It was extensively used by all areas in the institution for administration of the standard registry types - enrolment - fees in conjunction with the finance section - FESR - student statistical data. The student file was linked to a detailed course planning file. All these files could be integrated, using a servicing matrix to determine SFTE (Student Full Time Equivalents) and BFTE (Building Full Time Equivalents) calculations for the current year and using further planning models for a five year forecast. Breakdowns between mode and level and the contribution of special or short courses were also included in this package. It was not possible to use the CDP applications form to convert an applications file into a pure enrolment file because of the general missmatch between offers and enrolments and the high level of applications in the summer period. However, the file was used extensively in re-enrolment and was a major aid in the overall planning process. The development of FIND2 - developed by ICL - increased drastically the range and type of analyses possible using this and other file areas. While it caused considerable systems problems initially, its use by non-programming staff was seen as an advantage which out-weighed its implementation difficulties.

THE STAFF FILE

The staff file was in use by the academic staffing office and personnel in late 1976. The finance office was involved from the start of the project with the hope that the file could be used to forecast salaries more accurately on an annual basis.

It offered an ideal test-bed for examination of computerisation on staff unfamiliar with such technology. While the team experienced teething troubles, much useful administration was produced. It threw up all the problems associated with moving

from a manual to a computer system, but at the end of the initial period the advantages outweighed the disadvantages.

The system plugged into an existing data flow system, necessary to produce the payroll file at the LEA. While it was not feasible to move to a personally administered payroll system it produced information of considerable value in the planning process, particularly in view of the high cost of staff in relation to other resources. It would not otherwise have been possible to produce such detailed analyses, as the LEA would not have had the time or staff to do so. The amount of information collected on staff was a small proportion of that collected manually in the respective staff offices. The file set up with the full involvement of the staff and unions was initially planned as an administrative back-up model. However, it soon proved a valuable management and planning tool as a more critical picture of the staff profile became possible. This resulted in numerous requests by the departments to increase the scope of the file to include academic subject area and training profile data, as well as age and grade by sex.

THE FINANCE FILE

A limited amount of work was carried out, mainly concerned with basic accounting. More detailed work was concentrated in developing a cost planning model in the academic planning file.

THE SPACE FILE

A detailed rooms file had been in use since early 1975 although, because of work pressures, this file was still maintained by the computer centre for the appropriate assistant director.

ACADEMIC PLANNING FILE AND THE ACADEMIC PLANNING PROCESS

The design strength of the overall data system was severely tested in this area, as it must integrate itself on the decision process. This called for careful analysis if it were not to change drastically the decision mechanisms. It was inevitable that a formalised planning system would require many informal decisions to be integrated for consistency. This would require changes in decision-making levels throughout the institution if the system were to work.

The overall five-year plan for the institution was built from the bottom up. The structure was agreed in advance to ensure consistency of data and other relevant design parameters. The nature of the plan meant that each year, the plan was rolled one year forward and the results of the previous year's forecast compared to actual results achieved. Resource allocation could be investigated and course development monitored closely to ensure maximum effectivess in periods of limited growth.

PROBLEMS EXPERIENCED IN DEVELOPMENT

The formation of MIC was an acceptance by the institution that an ad hoc, demand-related system would create problems of inconsistency in data collection. Working on a model illustrated in Figure 3 (page409) could lead to a number of serious information system problems. It is perhaps worth briefly outlining some of these problems, as all were experienced within the Centre during its development. They refer to both human and systems-related interactions and to questions the institution had to ask when designing the system. In some cases, solutions to particular problems are given.

CATEGORY A - GENERAL POLICY STRUCTURE PROBLEMS:

- A consistent policy on data collection is seen as a secondary activity and simply the responsibility of the administration.
- The concept of effective management, corporate planning, and line management has been seen as inappropriate in an educational environment.
- Many institutions do not see their internal academic policy and resource management process as an overall system, where data or information collection is an integral component in this process.
- Immediate information demand problems are solved in an ad-hoc manner rather than in relation to a general data collection policy.
- The design of a data collection system should not be seen as something outside the system, rather as an integral part able to assist in difficult decision processes.
- What decisions/policy can the institution make without reference to the LEA/DES/CNAA/RAC? What is the internal decision making/policy process within the institution?
- How do the various resources interact?
- How do external factors affect the internal decision process?
- How does the system overcome the changing external demand which creates discontinuties with the internal data base?
- How much should external demand affect the internal design of the data base?
- External demand can shift the internal decision process away from its defined position.
- Bad internal design can shift the emphasis of the decision process.

- Critical to the success of an operation, is the ability to inform all those involved, regardless of level, the purpose of the data collection system.
- Why are we collecting the data?
- Why is there duplication of an existing manual system?
- What is the data being used for and where is it going?
- How will it affect the decision process?
- How is it going to be interpreted once it has been submitted?
- How is it going to help me in my job?
- Why does it have to be submitted in this form?
- The production of a data element dictionary distributed to all staff in the system is of critical importance. It should explain the various inputs affecting the user or supplier of information. Where conversions are used of raw student, staff or space data, number of hours into full time equivalent students (SFTEs) or building full time equivalent students (BFTE), the conversion factor should be explained; the actual conversion should be carried out centrally. The conversion factor should be further clarified by the body defining the factor (DES, institution, LEA, Burnham).
- If student numbers are used for resource allocation, the constantly shifting student population should be taken into account.
- If all users are reliant on the Centre, trust and competence are factors which will loom large for the user. This process, in the early stages of conversion, can be reinforced by a personal approach, i.e., no new data collection is instigated without personal contact with the user to explain and guide him through the initial training process.
- Personal contact with the data generator or supplier is of critical importance, if the system is to be successful.
- Training and development programmes, particularly for data management staff, are critical. These staff, particularly where software packages are available, are the key link between the user and the Centre. The level of expertise generated far exceeded initial predictions. Some staff were capable of programming and were able to provide valuable help to the systems and

programming team.

- When resources were limited, it was found more effective to use these resources on the data staff, than risk further development of the system. Clearly, this statement has an upper bound, but cannot overemphasise the importance of this resource.

CATEGORY C SYSTEMS-ORIENTATED PROBLEMS AND SOLUTIONS

- Academic computer work is essentially different from administrative planning and management work.
- Deadline dates - program testing - data security - file sizes - and need for on-line systems - all represent problems to indicate separate machine solutions.
- Changing external demands cause considerable systems development problems with an internally maintained system.
- Most users consider anything less than real time system for their exclusive use less than an efficient solution.
- Priority lines must be set up in sensitive file areas to ensure integrity of access. To solve this problem, agreed personnel listed for all file areas.
- While one of the agreed aims of an MIS is to provide more readily available and accessible information, the user has to be trained into planning his normal information needs over a yearly cycle. MIC asked each known user his likely information demands over the year. A yearly work load profile was produced, and from this it was possible on a day-to-day basis to deal with random demands. A priority list was prepared and categories of information demand listed so that users could get a clear idea of likely time for a request. Without such structuring, the system became overloaded.

CONCLUSIONS

The NELP system proved of considerable benefit although throughout its development, questions were raised as to its relevance and effectiveness. All the problems that were likely to occur in the development of an MIS did occur. Many mistakes were made which, on hindsight, could have been avoided. However, through these mistakes and their eventual solutions real conclusions could be drawn.

It is now possible, with the considerable advance in software and technology over the last eight years, to overcome many of the system's problems.

- The critical success factors now relate more to the person system interface and to the public relations approach used when introducing a new system. There is no question that a system with the right software will fail if the user is unclear of his role and purpose of the system. It must be emphasised that the system is at the service of the user, rather than vice versa. A system designed to alienate the user must fail.

- Once a clear analysis has been made of the decision process, it is probably more effective to introduce the component parts of an MIS one at a time, over a period of years, rather than to introduce the system in one go.

- Considerable emphasis must be placed on the user and on the training of data mangement staff. This particular factor is a key one, as staff can be readily trained to fulfil this role. They represent a major resource available to all institutions and should not be confused with the data clerk found in business (although, before going into data mangement, staff would have to pass through a data clerk stage).

- A data element dictionary is critical, not only to the institution, but at an LEA and national level. There is a need, if systems costs are not to escalate, to agree a national base of data in the areas of staff, students' space finance and courses. If one moves above this basic level, programmes are more difficult to define.

- There is no question that MIS will be of critical significance to all institutions over the next 20 years. As staff costs rise, it becomes a major factor. Research activity was not dominant in the first year or so of development, but was seen increasingly as crucial to the success of the Management Information Centre. There were important benefits in planning and in academic spin-offs. The development of a real data processing operation and associated techniques, such as DDE, DED and IDMS, was of direct relevance to students training in computing and business. The Centre hoped this aspect of the work could be expanded in view of the critical importance of computing in society.

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